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**Rule CIC420:** A large percent of CFDT structure list entries were in use

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**Finding:** The CICS Coupling Facility Data Table (CFDT) Pool Server statistics showed that a large percent of CFDT structure list entries were in use for the coupling facility structure containing the CFDT pool.

**Impact:** This finding has a MEDIUM IMPACT or HIGH IMPACT on the performance of the CICS region.

**Logic flow:** This is a basic finding, based on an analysis of the data. The finding applies only with CICS/Transaction Server for OS/390 Release 1.3, or for z/OS.

**Discussion:** The CICS Coupling Facility Data Tables support provide a significant enhancement to shared data tables in a parallel sysplex. The CFDT design provides an excellent way to share file data using CICS file control, without resorting to VSAM record level sharing (RLS). The CFDT design eliminates the requirement for having a File Owning Region (as is required with normal shared data tables).

CICS CFDT support is designed to provide sharing of working data within a sysplex, while maintaining update integrity of the data. The working data is held in a coupling facility data table, which is contained in a *named pool* located in coupling facility list structure. There can be multiple CFDT pools, each containing one or more CFDTs. Each CFDT pool is defined, using MVS cross-system extended services (XES), as a list structure in a coupling facility.

Access to a CFDT is via a *CFDT pool server* that supports a specific named pool. A CFDT pool server is started in an MVS image by starting a pool server region (as either a batch job or a started task) for each CFDT pool. Starting the pool server region invokes the pool server region program, DFHCFMN, which resides in an APF-authorized library. Each CFDT pool server provides access to only one CFDT pool, so there must be multiple CFDT pool servers if there are multiple CFDT pools.

A variety of parameters are provided to the CFDT pool server, to specify the name of the CFDT pool, list structure attributes, tuning parameters, various thresholds for warning and automatic server actions, etc. These parameters (other than the pool name, which has a default *prefix* of DFHCF) have default values, but the defaults can be changed based on user-specific requirements.

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The application tasks issue standard CICS file control commands to read, write, browse, or delete CFDT records (READ, READNEXT, READPREV, WRITE, STARTBR, and DELETE). The pool server is responsible for translating these application task commands into XES list structure interfaces.

A list structure consists of a set of lists and an optional lock table of exclusive locks (which can be used to serialize the use of lists, list entries, or other resources in the list structure). Each list is pointed to by a *list header* and can contain a number of *list entries*. With CFDT pools, the list structure is the named pool, while the lists themselves are CFDTs within the named pool. The CFDT pool server designates the maximum number of lists (or tables) the CFDT pool is to have, and allocates the list structure based on parameters that are provided to the CFDT pool server.

A list entry consists of list entry controls and can optionally include an *adjunct area*, a *data entry*, or both. Data entries are composed of units of storage called *data elements*. In a coupling facility of CFLEVEL=0, data entries can be composed of 0 to 16 data elements. In a coupling facility of CFLEVEL=1 or higher, data entries can be composed of 0 to 255 data elements. In either case, a data entry could contain up to 64K (65536 bytes) of data.

When the list structure is allocated, XES establishes the number of data elements that are associated with data entries. This division of storage is referred to as the “entry-to-element ratio”.

The structure *alter* function provides for the expansion or contraction of the size of a structure, the reapportionment of the entry-to-element ratio of the structure's storage, and the alteration of the percentage of structure storage set aside for event monitor controls (EMCs). The structure alter processing is done either by using the IXLALTER macro or by issuing the SETXCF START,ALTER command. The IXLALTER macro allows an authorized user to request a change to the structure's size, the entry-to-element ratio, and the percentage of storage allocated for EMCs.

Starting with OS/390 Release 10, a structure can be *automatically* altered when it reaches an installation-defined or defaulted-to percent full threshold as determined by structure full monitoring. The alter process may increase the size of the structure, reapportion the objects within the structure, or both.

With CFDT pools, the pool server monitors the total number of data entries and data elements in use in the structure, using information returned by the coupling facility on every request. When the numbers in use exceed thresholds specified by the CFDT pool server *warning parameters*, a warning message (DFHCF0411 or DFHCF0412, for entries and elements,

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respectively) is issued. The warning message is repeated each time the number in use increases beyond further thresholds.

Each time the warning is issued, the CFDT pool server tests whether an automatic ALTER for the entry to element ratio should be performed. The test is done based on the CFDT pool server *automatic structure alter parameters*. This is based on the ratio between the current numbers of elements and entries actually in use.

IBM suggests that no more than 75% of the structure be used, to minimize the risk of the structure becoming full, to avoid triggering low space warning messages, and to avoid additional activity required to alter entry to element ratios. However, the default ELEMENTWARN and ENTRYWARN warning parameters have a default value of **80**, which specify that warnings and automatic ALTER actions should be first triggered when 80% of the elements or entries are used.

Section 2.10.8.4.2 (Approximate storage calculations) of the CICS/TS *System Definition Guide* provides calculations that can be used to calculate initial sizing of the storage for a CFDT pool. However, this algorithm might not yield an adequate structure size for some environments.

Further, the default element to entry ratio in the CFDT pool server *tuning parameters* is a simple 1:1, which might not be optimum for any particular CFDT environment.

Consequently, CPExpert provides an earlier warning of structure element and entry shortage by analyzing the maximum number of elements and entries that were used.

CFDT pool server statistics for the coupling facility are available in MXG file CICCFS6D. CPExpert uses data in CICCFS6D to calculate the maximum percent of the structure list entries that had been used, using the following algorithm:

$$\text{Maximum percent structure list entries used} = \frac{S6ENTRHI}{S6ENTRMX}$$

where    S6ENTRHI    = Maximum number of list entries used since last reset  
          S6ENTRMX = Total list entries in the currently allocated structure

CPExpert produces Rule CIC420 when the maximum percent structure list entries used is more than the value specified by the **CFPCTENT** guidance variable in USOURCE(CICGUIDE). The default value for the **CFPCTENT**

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is 70 indicating that CPExpert should produce Rule CIC420 whenever more than 70% of the list entries had been used.

**Suggestion:** Rule CIC420 indicates that the CFDT pool server either is exercising automatic alter algorithms, or is likely to exercise these algorithms as the thresholds in the *automatic structure alter parameters* are reached. If this finding is produced often, you should consider the following alternatives:

- Increase the initial amount of structure space that is available for the CFDT pool identified by this finding. Increasing the amount of initial structure space can be accomplished by increasing the INITSIZE (so more structure space is initially available). If more structure space is initially available, more entries and elements will be available and there is less probability that there will be a shortage of list entries.
- Increase the amount of storage allocated for the *maximum size* specified in the coupling facility resource management policy for the CFDT pool identified by this finding. This action normally should be taken only if the structure size has approached the maximum size specified. Be aware that Rule CIC425 will be produced if the structure runs out of space, but frequent occurrence of Rule CIC420 might indicate a pending “no space” condition.
- You could change the CFPCTENT guidance variable in USOURCE(CICGUIDE) so Rule CIC420 is produced less often. This action is not recommended, however since you should be aware of the potential problems (it is particularly important to be aware of pending problems) revealed by Rule CIC420

**Reference:** CICS/TS for OS/390 Release 1.3  
*CICS System Definition Guide*: Section 2.10.8 (Coupling facility data tables)

CICS/TS for z/OS Release 2.1  
*CICS System Definition Guide*: Chapter 27 (Starting a CFDT server)

CICS/TS for z/OS Release 2.2  
*CICS System Definition Guide*: Section 4.3 (Starting a CFDT server)